Overwintering Of Honey Bee Colonies

Production Research Report No. 169

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE
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Abstract

Requirements of overwintering colonies of honey bees are strong, vigorous colonies with abundant winter stores (90 lb (40.8 kg) honey in October) in the proper position in the hive. Winter consumption of honey and its effect on colony yields the following season were calculated for 1,034 colonies over 8 years and show an average yield of 49 lb (22.3 kg) more honey for colonies that consumed more winter stores than the average from October to April.

Cessation of brood rearing in August, September, and October resulted in corresponding reduction in production the following summer of 141, 106, and 60 lb (64, 48.1, and 27.2 kg) compared to colonies allowed to rear brood into late fall. A test conducted during two winters using cut-away hive bodies with exposed combs emphasized the importance of wind protection for winter survival.

Key words: honey bees, overwintering, combs, package bees, queens, beekeeping management, and brood-rearing.

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FLOYD E. MOELLER[1]

Introduction

Honey bees, *Apis mellifera* L., are kept by man in bee hives, but bees are not domestic animals in any sense of the word. Man adapted his handling and management of these insects by fitting his methods to meet their natural behavior. Bees are no different in their needs or behavior today than were the wild honey bees in the forests at the time of the cave man. When bees swarm from modern hives, they readily return to their wild condition. They have been on earth since the Jurassic period, 160 million years ago, and have survived without man's help. The ideal conditions for winter survival in man's hives must thus approximate what is best in nature.

An analogy made by the late Dr. Farrar (5)[2] stated that a honey bee colony is in reality an organism and that the colony lives from now on, unless the victim of disease, starvation, or catastrophe, whereas individual bees of the colony die or are replaced continuously, as are the cells of any living organism. Reproduction of this colony organism is by swarming.

Honey bees were brought to the Americas by early European immigrants. The bees soon escaped from the settlements, went into the wilds of the new world, and lived in hollow trees and caves. When left to their own resources they are adaptable and have little trouble surviving severe winters. Only when man interferes do problems develop.

Bees build combs in many and varied cavities: hollow trees, between the studs in walls of buildings, attics, caves, or any suitable shelter. The main purpose in choosing such enclosures is to provide the colony with protection from winter winds. No attempt is made to heat or control the temperature of the chosen cavity.

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[1]Research entomologist, Bee Management and Entomology Research, Agricultural Research Service, Madison, Wis. 53706

[2]Italic numbers in parentheses refer to Literature Cited, p. 14.

Perhaps no other subject in beekeeping management has been discussed and argued as much as methods of overwintering honey bee colonies. Many northern beekeepers over the years have killed their colonies in the fall and depended on package bees for spring replacement. With higher honey prices, many southern package bee producers are turning to honey production. Intense interest is expressed by beekeepers in overwintering colonies of bees, largely because of the unavailability of package bees and queens and high prices.

The package bee colony, 2- or 3-lb (1- or 1.5-kg) size, requires about 11 to 12 weeks to reach maximum population (*6*). This is governed by the length of time required to develop a bee from the time the egg is laid to emergence (20 days), by the longevity of the bees (30 to 35 days), and by the amount of brood a given population can support (*3, 7*). A package of bees installed May 1 will consequently reach peak population about August 1. This means that if a major honey flow occurs June 15 to August 1, the colony is building its population on the flow and does not store a maximum crop.

A properly managed overwintered colony reaches its peak June 15 (at the start of the flow) and is capable of maximum production. For this reason, overwintered colonies are preferred. In areas where a maximum crop from an overwintered colony is 250 lb (113.6 kg), the package colony may produce only 80 to 100 lb (36 to 46 kg).

Bees store pollen and honey during the active summer period. This cache of food stored in vertically hanging combs is slowly consumed during the winter. Brood rearing begins about the first of January, and the brood area expands as food and exterior temperatures permit. In the area occupied by brood, the temperature is maintained at about 92° to 93° F (33° C).

At the outer periphery of the roughly spherical cluster occupying the interspaces of the combs, the bees are tightly packed to form an insulating band or shell. The outer edge of this cluster never falls below 43° F (6.11° C) (*10*) and is usually in the mid-50° (12-13°) range. If the body temperature of a bee falls to 42° (5.56°), it loses the power of motion and will drop. At 28.5° (1.94°) the body tissue freezes solid. Thus, to maintain life the temperature cannot go below 43° (6.11°).

In the remainder of the hive space not occupied by bees, the temperature falls just as low as the outside. Colonies that build combs in such exposed places as on limbs of trees cannot withstand the cold, piercing winds of northern climates and will not survive. Thus, the main purpose for seeking the confines of a cavity seems to be wind protection.

Requirements for Good Overwintering

Colony strength and condition

A colony population of adequate strength for winter is a prime requisite. At the close of brood rearing in November, a colony of suitable population should fill at least two standard 10-frame hive bodies from wall to wall and top to bottom at a clustering temperature of about 40° F (4.44° C).

Smaller colonies should be united, and only first-class colonies should be overwintered. A poor policy is to attempt to overwinter subnormal or weak colonies, because they seldom will survive. Weak colonies that perish in late winter or early spring probably will be laden with nosema disease. As they are dying, they defecate nosema-laden feces on the combs and equipment, adding difficulty to replacement with package bees. The potential winter loss is best taken at the start of overwintering to keep the equipment clean and conserve honey. In the spring, strong, overwintered colonies can easily be divided and colony numbers doubled or trebled.

The age of the bees going into winter is as important as population size. Late summer and fall brood rearing should be encouraged. This can be accomplished by using young queens and providing ample pollen and honey. Young queens of the current year will lay eggs later into the fall than old queens.

An adequate pollen supply in late summer is necessary to support this late brood rearing, and in most areas pollen is usually available. If a colony has a poor, old, or failing queen, or if the bees have been queenless for a prolonged period in late summer, the population may have a higher than normal proportion of old bees as it goes into winter. When this situation occurs, the population size may look adequate in late fall, but, as winter progresses, the population may shrink faster than winter brood-rearing can compensate, eventually resulting in a colony loss. Such weak colonies may become still further weakened by nosema disease and may perish.

Two tests conducted at Madison, Wis., illustrate the effect of late fall brood-rearing on overwintering success and honey production the following season. At one location, groups of 12 to 13 colonies each, all of the same hybrid stock, were used in tests in which brood-rearing was curtailed early and late by caging queens at different intervals. Queens of one group were caged on August 15, a second group on September 15, and a third group on October 15; the queens of the fourth group were not caged. All queens were released on December 15. The same test was repeated the next winter using groups of 11 and 12 colonies,

TABLE 1.—*Effect of early termination of brood-rearing in the fall on honey production the following summer, Madison, Wis.*

	Average gain			Colony losses April
First year:	*Pounds*		*Kilograms*	*Number*
Queens not caged	317	[1](11)	144	1
Queens caged from 10/15-12/15	271	(9)	123	3
Queens caged from 9/15-12/15	300	(6)	136	6
Queens caged from 8/15-12/15	237	(3)	108	10
Second year:				
Queens not caged	264	[1](11)	120	0
Queens caged from 10/15-11/15	208	(9)	95	2
Queens caged from 9/15-11/15	162	(9)	74	3
Queens caged from 8/15-11/15	127	(6)	58	6

[1]Number (in parentheses) of colonies represents the average.

all of the same hybrid stock. In this test, all queens were released on November 15.

In March when pollen supplement was fed, colonies with queens caged in mid-September and those caged in mid-October had good populations. Those with August curtailment of brood-rearing were noticeably weaker. After brood-rearing expanded in May, these relative population differences persisted.

Final production records for normal colonies in each of the test groups are shown in table 1. The caging of queens in October near the normal cessation of brood-rearing had less effect than caging of queens in August or September to terminate brood-rearing. Cessation of brood-rearing in August, September, and October resulted in corresponding reductions in production the following summer, depending on how much fall brood-rearing was prevented.

Where queens were caged in August, colony losses over winter were high—10 of 13 the first winter and 6 of 12 the next. Later caging showed correspondingly less winter loss.

Young, vigorous queens must be present in late summer. Any colony showing poor brood quality or quantity should be examined closely for possible queen replacement. Poor queens are often replaced or superseded by the bees in late summer without the beekeeper's intervention, but for best results the beekeeper should be alert to the possible need to requeen. A regular requeening schedule is a part of good management.

Some stocks rear brood later than others. This stock characteristic, along with a heavy or compact brood nest, makes certain strains of bees more or less suited for overwintering.

Honey stores

A full-strength colony of honey bees in most of the northern tier of States and in Canada will require no less than 90 to 100 lb (41 to 46 kg) of honey stores to survive from October to April. The average colony of bees in this area will consume about 60 lb (27 kg) of honey during this period, especially if pollen supplement is fed during March and April, as it should be. Some colonies may use only 20 to 25 lb (9 to 12 kg), whereas the better class of colonies will use up to 80 lb (36.3 kg). To insure survival of the stronger colonies, with a margin of extra honey for insurance, 90 to 100 lb (41 to 46 kg) of honey should be left. The gross weight of a 3-story colony in 9½-in (24.1 cm) 10-frame equipment should be no less than 175 lb (80 kg) in October.

Sixty pounds (27 kg) of honey for overwintering is not too much in southern areas. Shorting a colony by a pound (0.45 kg) of honey may result in the death of that colony; but a 50-lb (22.7 kg) reserve could mean that the colony needs to store that much less for next year.

Strong colonies will usually consume considerably more honey over winter than weak colonies. However, such strong colonies will usually replace most of the honey used during the winter with new honey from willow, dandelion, fruit bloom, and other early blooming sources, under the same conditions that under-developed colonies continue to lose weight or show little or no gain. The strong colony that has a large population of young bees by mid-April not only shows a smaller net loss of reserve stores at the beginning of the surplus flow in June than a subnormal colony, but also is stronger and more capable of producing a large surplus crop.

Remember, most colonies that starve because of lack of honey in the hive in late March or early April are usually the most populous and are potentially the best producing colonies because they have been most active in brood rearing. Winter and early spring brood-rearing is highly desirable to build first-class populations of young bees that will gather a maximum crop of honey. To accomplish this, the colonies must have adequate supplies of pollen or pollen supplement and a large honey reserve.

Farrar (*4*) calculated the winter consumption for 416 colonies and found consistently higher production from those colonies that consumed the greatest amount of honey over winter. He concluded that on the average, high winter consumption results in greater net yields and a still greater advantage if productivity is measured in terms of pollination. Because pollination is directly proportional to the number of flower visits, the high summer gains become important.

Winter honey consumption and its effect on colony yields the following season were calculated for 1,034 colonies spanning 8 years at

TABLE 2.—*Influence of winter honey consumption on honey yields the following season*

Consumption	Colonies	Average consumption October to April		Average yield October to October	
	Number	*Pounds*	*Kilograms*	*Pounds*	*Kilograms*
Above average	472	65	29.6	179	81.4
Below average	562	47	21.4	148	67.3
Difference	——	18	8.2	31	14.1
Increased gain April to October	472	—	——	49	22.3

the Madison laboratory using intensive methods of management (table 2). Average winter consumption for these years was 59 lb (26.8 kg).

The difference in gain during the active season (April to October) is 18 lb (8.2 kg) plus 31 lb (14.1 kg) totaling 49 lb (22.3 kg). Thus, the group of colonies that consumed above the average in winter stores produced an average gain of about one standard super of honey more than the colonies that consumed less than average.

Although colonies with insufficient winter stores must be fed in the fall to bring their net weight to a minimum standard of 90 lb (40.8 kg), feed only what is needed because the handling and ripening of excessive amounts of sirup will place undue stress on the bees going into winter. If large amounts of feed are required, provide full combs of honey insofar as possible. Heavy fall feeding stress may be reflected in reduced honey production potential the following summer. This was indicated in a test at Madison and will be explored further.

Well-ripened honey or sugar sirup stores should be used for best results. If colonies have a predominance of honeydew honey, or if the honey has a high moisture content, dysentery may occur. The complex sugars in honeydew honey cannot be digested by bees and pass into the gut as wastes. If honey becomes solidly granulated in the combs, as frequently happens with dandelion or rape honey, the bees have some difficulty in making good use of these stores. They may use the liquid portion surrounding the dextrose granules, resulting in a diet with high water content leading to dysentery, and they may waste most of the dextrose crystals, which drop to the bottom board of the hive.

Not only important are the quantity and quality of honey stores for the overwintering colony but also important is the position of those stores in the hive. The overwintering cluster gradually moves upward onto combs of honey just above them. Surplus honey is stored above the active brood nest during the summer, thus full combs of honey are normally available to the bees above their clustering position during

the winter. The beekeeper by "manipulating" his hives may upset this organization or may be so greedy as to remove too much of the surplus crop, thus resulting in the colony's demise. Honey not in a favorable position in the hive may be moved by the bees into their cluster location whenever hive temperatures permit.

Ideally in the fall, the top brood chamber should be nearly filled with sealed honey in dark brood comb. Bees cluster more readily on dark brood comb and are somewhat reluctant to work upward onto new white honeycombs that have never been used for brood rearing. The top box should have no less than 45 lb (20.4 kg) of honey in November, and this means that all combs in standard 9½-in (23.13 cm) hive bodies are sealed to the bottom bars except perhaps the center two or three combs. Three standard hive bodies are necessary to accommodate 90 to 100 lb (40.8 to 45.4 kg) of honey in the fall and still have sufficient comb for good clustering. The lower two hive bodies should each have 25 to 35 lb (11.3 to 15.9 kg) of honey plus pollen.

Precise hive weights are not necessary. Adequacy of weight can be determined by simply lifting the top hive bodies. With practice, one can learn to estimate weights of hive bodies quite accurately by lifting.

Pollen reserves

Todd and Bishop (*11*) determined that 1 lb (0.45 kg) of pollen will maintain about 4,540 bees; and with some 200,000 bees reared by a colony a year, 44 lb (20 kg) of pollen would be consumed during a year. Perhaps more than 50 lb (22.7 kg) of pollen are consumed by a strong colony to support its brood-rearing. Most of this is consumed during the summer, but a reserve of pollen stored as bee bread is also necessary to support brood rearing during the winter (*1*).

Most colonies will be broodless during November and December but will begin some brood-rearing about the end of December, regardless of outside temperatures. This is a normal condition throughout North America. Strong colonies with adequate pollen reserves in the combs may replace their fall population with young bees by the time new pollen is available in the spring (*2*). The amount of reserve pollen required in the fall depends on the abundance and time of bloom of the early spring sources of pollen. Where spring sources are not adequate or bloom occurs later than March, pollen supplement will need to be fed to bridge the shortage.

Adequate pollen reserves year round will insure healthy, strong populations of bees. This is most essential for the overwintering colony. Brood-rearing, made possible by adequate pollen, also results in a greater consumption of honey stores. Beekeepers should always be aware of the cache of honey in the colonies and never allow colony

reserves to become dangerously light. When pollen supplement is fed in early spring before much flight is possible for foraging, the colonies must draw upon the honey remaining in the combs from the previous fall. Most of the 90-lb (40.8 kg) reserve of honey left in the colony in October is consumed during early spring brood-rearing before settled, warm weather returns. During March and April most so-called winter loss occurs from starvation.

Entrances

For every 10 lb (4.5 kg) of honey that a colony consumes, about 1 gal (3.8 l) of water is produced. This water escapes from the overwintering colony as vapor. Provision should be made for the escape of this moisture-laden air, or ice may form on the cover above the cluster and drip over the bees during thawing. Some frost formation on the cover is not objectionable, but excess frost or ice is not good. A top entrance for the overwintering colony will allow the moist air to escape, as well as provide a ready flight entrance during thawing when cleansing flights are possible. Most practical is a 1- or ¾-in (2.5- or 1.9-cm) diameter auger hole provided in the top hive body just below the front hand hold.

All hive bodies used as year-round brood chambers should have their auger-hole entrances corked shut except for the top box during the winter. When snow is deep, the bottom boxes may be below the snow line and an entrance to the top box will allow winter flight.

The lower combs are normally not occupied by bees during the winter, making an attractive nesting site for mice that can severely damage brood combs if they can gain entrance. The lower entrance should be screened or reduced to the smallest possible opening to exclude mice. Entrance cleats are commonly made with a small, ⅜- by ¾-in (0.7- by 1.9-cm), opening for winter use.

Disease

Nosema disease is the most serious disease for the overwintering colony. The prolonged confinement and reduced brood emergence during winter enhances the opportunity for buildup of nosema (9). Unchecked, nosema disease seriously weakens colonies and may lead to their loss in late winter or early spring. Fumidil B[3], fed in sirup in late fall, is an excellent management practice to suppress nosema buildup during winter. A gallon (3.8 l) of heavy sugar sirup containing

[3]Trade names are used in this publication solely to provide specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

100 mg of fumagillin fed to the colony at the close of brood-rearing will be stored in the area where the last brood emerged and is the first food used by the colony at the onset of winter. This suppresses nosema disease development and prevents more serious development of the disease that may occur without such treatment (*8*).

A thorough check for brood diseases and colony condition should be made early in the fall as soon as the honey crop has been removed. Preventive drugs such as Terramycin or sodium sulfathiazole should be used for any colonies exposed to brood diseases. Three or four gorging applications at 4- to 5-day intervals with about 1 pt (0.5 l) of heavy sugar sirup containing ½ to 1 g of sodium sulfathiazole per gallon (3.8 l) or 3.3 g of Terramycin (TM25) per gallon of sirup can be used. Dust treatments may be used as an alternative.

Brood diseases should be controlled in colonies well in advance of the overwintering period. Diseased colonies are a serious hazard to all colonies in the apiary. They are often weaker than normal, become candidates for nosema buildup, and as a result may become seriously weakened or die by late winter or early spring. If undetected at that time, stronger colonies may overpower them and rob honey, thus transmitting brood diseases throughout the apiary.

Wind protection

Wind protection is paramount in overwintering colonies. Colonies of bees in nature tend to seek sheltered cavities in which to build their nests, primarily to protect themselves from the chilling effect of winter winds. This was emphatically demonstrated in two seasons of testing at Madison, Wis. In each of these seasons, eight colonies of similar strength and of the same stock were selected in October. Four were overwintered in conventional wooden hives without additional protection. Top 1-in (2.5 cm) auger holes were provided. The other four were placed in hive rims with cutaway sides fitted with window screening (fig. 1). Thermocouples were placed in the interspaces of the middle frames of each hive body.

Temperatures within the clusters in both types of hives in both years were similar through January. Brood-rearing temperatures of 92° to 93° F (33° C) were recorded in all colonies, even with surrounding temperatures in the subzero range.

In one season, 2 weeks of subzero temperatures in February with high winds 20 to 30 mi/h (33 to 49 km/h) resulted in the death of all the colonies in open ventilated hives. The next season, again following a similar weather pattern, two of the open colonies were dead and two severely weakened. The four colonies in plain hives in both years were alive and in good condition.

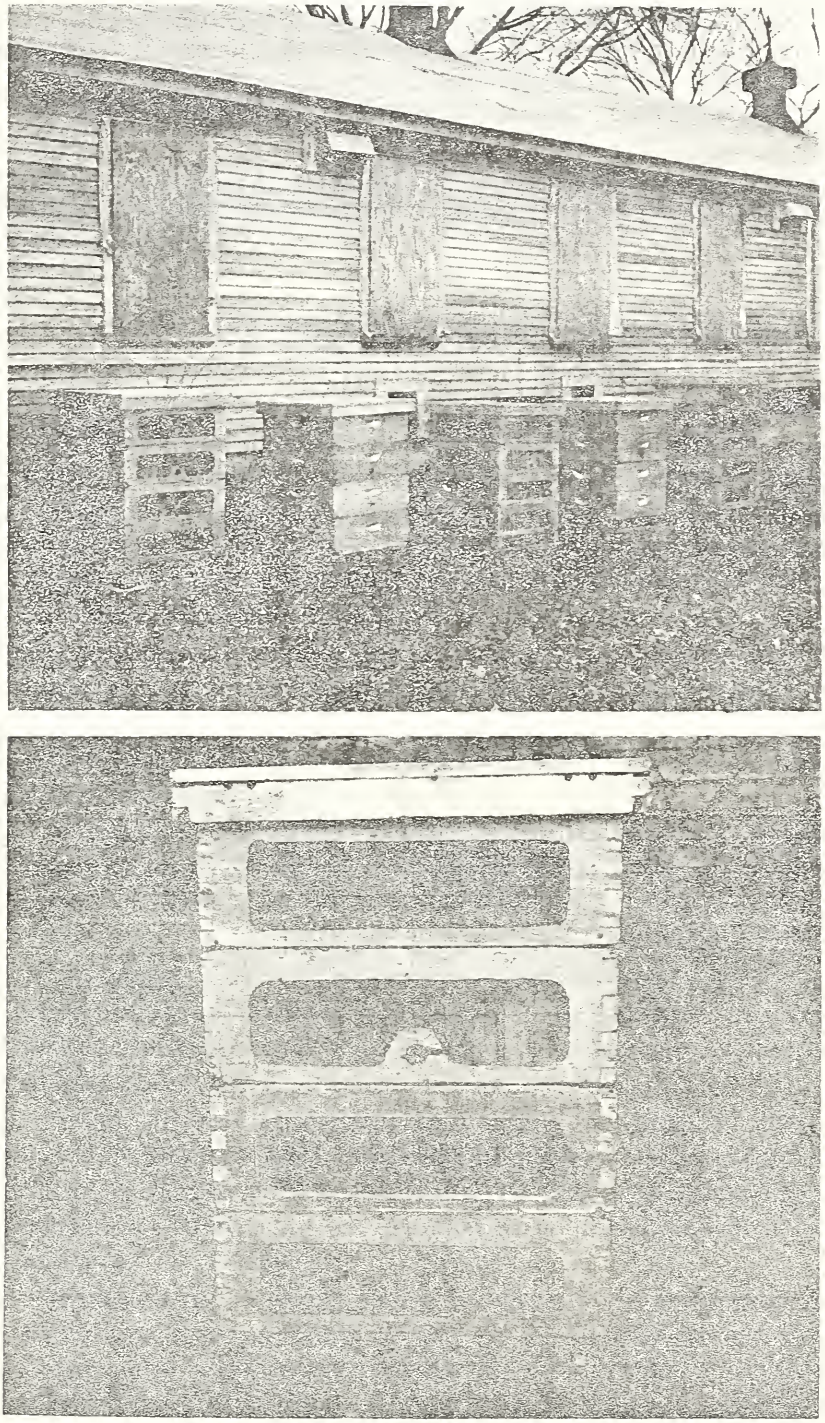

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FIGURE 1.—Hives with cutaway sides fitted with window screening to allow free circulation of air: *Top,* colonies with and without cutaway sides used in the test; *Bottom,* close detail.

Apparently such exposure to strong subzero wind chills the exposed bees at the cluster periphery, freezing them and causing them to drop. As the cluster erodes away in this manner, successive layers of bees are frozen, greatly weakening the colony and eventually causing its death.

Had the exposed colonies been in a quiet environment out of the wind, subzero temperatures would have been tolerated without ill effect.

Packing, Wrapping, or Cellar Wintering

The temperature inside the hive in the area not occupied by bees falls just as low as the outside temperature, whether the colony is packed or wrapped. The only difference is the rate of temperature change in the heavily packed hive is slower than in the lightly wrapped or unprotected hive. Insulation on the hive slows temperature changes within the hive. If warming periods that allow a brief cleansing flight in winter do occur, the heavily insulated colony may not be aware of the change and would fail to take advantage of a flight. For these reasons, heavy packing or insulation are not recommended. Most important considerations are the strength and condition of the bee colony, the amount and position of the honey stores, and adequate protection from the wind.

Packing or insulating beehives is costly. However, some savings in honey have been shown by packing colonies for winter. In windy locations a light tar paper wrap is valuable as a windbreak.

Colonies can be overwintered on the summer stands with no packing or wrapping if the essentials of population and quantity and position of honey stores are met. Tar paper or builders' felt may be stapled to the hives, with a hole allowed for the top entrance and the top edges folded under the hive cover to shed moisture.

When subnormal colonies are to be overwintered, cellar wintering, or its modern sequel, controlled-environment wintering, has been attempted. In the past, cellar wintering was plagued by nosema disease problems. Today, we use fumagillin to control nosema and insulate buildings or rooms.

Research is currently being conducted on controlled environment wintering. A temperature somewhere in the mid- or low-40° F (5° C) range, total darkness, ventilation to reduce excess moisture and humidity, and fall feeding of Fumidil B to suppress nosema disease are some of the major considerations. Provision for refrigeration should be considered also because sudden warming spells in late winter or early spring could result in undue restlessness and activity within the con-

trolled-environment room. Colonies on flat-bed trailers that can be rolled outdoors or back into the room during warm or cold trends also would be desirable.

In any decision to try controlled environment wintering, serious consideration must be given to costs of the building and labor and to risks involved in holding subnormal colonies over winter. Good outdoor-wintered colonies can be divided once or twice in the spring to make needed increase.

Cause of Winter Loss

Winter loss results primarily from starvation. Starvation results from (1) lack of honey (beekeepers should leave an adequate honey reserve), (2) improper position of honey (honey reserves below or to one side of the winter cluster, rather than above it), and (3) small population (unable to cover their honey stores properly).

A small population can be the result of queenlessness, nosema infection, lack of fall brood rearing, insecticide damage in late summer, or poor colony management from overcrowding a colony with honey by inadequate supering, which restricts fall brood-rearing. In any event, the small cluster in subzero cold may cover only 2 or 3 lb (0.9 or 1.4 kg) of honey rather than 40 or more pounds (18.1 kg) as is true of the large, populous colony.

A colony prevented from rearing a normal amount of brood in late summer and fall (because of crowding or queenlessness) may look populous enough in early winter. However, such a colony will be comprised mostly of older bees. They will die early in winter, which results in a small population later on. A sublethal dose of insecticide in late summer or fall may also reduce bee longevity or disrupt normal brood rearing.

Another major cause of winter loss is lack of wind protection. Colonies in exposed, windy locations will quickly become weaker because bees at the periphery chill, drop, and may eventually starve as the populations no longer can cover adequate stores.

Expected winter losses, when all requirements for good overwintering are met, should be about 1 to 3 percent of the colonies overwintered, and in many years can be nonexistent.

Insuring Successful Overwintering

Late summer and fall

During the last 2 weeks of the major honeyflow, colonies should be top supered, that is, add empty supers above the partly filled supers to crowd winter honey stores into the brood nest.

After the major honeyflow is past and all honey supers have been removed, check colonies for brood diseases and for condition of queens. Late summer is the time to replace old, defective queens and to treat colonies with drugs to control or prevent brood diseases.

Organization and amount of winter stores should be checked as colonies are inspected. If additional weight is needed, feed a heavy sugar sirup (2 parts white, granulated sugar to 1 part water by weight). Complete this feeding by about October 15 in the northern tier of States and southern Canada.

In late fall, when brood-rearing subsides (or stops in many colonies) feed 1 gal (3.8 l) of heavy sugar sirup containing 100 mg fumagillin as Fumidil B for nosema control. This sirup will be stored where the last brood emerges and will be the first food used for winter, thus suppressing nosema in early winter.

Finally, make sure that all colonies have top winter flight entrances and that the lower entrance is screened or reduced to prevent mice from entering.

Midwinter check

Colonies should be checked in midwinter on mild days with little wind. Most colonies should be in good condition if details were attended to in the fall. Gently remove the cover and confirm the colony condition without disturbing it. The only purpose of this inspection is to see that the clusters are normal and in contact with ample honey stores. A colony can often be saved by reorganization in February, if the colony is stranded on brood away from its honey. Honeycombs or even combs filled with warm sugar sirup poured from a sprinkling can, may be placed in contact with the outer edges of the clustered bees.

Early spring inspection and feeding

By early March, in most northern States, colonies will be ready to receive pollen supplement. Once such feeding begins, provide the supplement as fast as the bees will consume it and until they can begin foraging in the field.

A satisfactory pollen supplement formula is, by weight, 2 parts sugar and water and 1 part expeller-processed soybean flour and bee-gathered pollen by weight. The sugar-water fraction is 2 parts sugar and 1 part water. The soybean flour-pollen fraction is 1 part pollen and 3 parts flour by weight. Brewers' yeast can be substituted for the soybean flour fraction, but less water must then be used to obtain proper consistency. If pollen is not available, the soybean flour or brewers' yeast can be used alone as a third of the mix, but it is not as effective as materials including pollen.

Fumidil B can be incorporated in the sirup portion of pollen supplement at least for the first round of feeding to retard nosema buildup. Do not feed supplement to weak or subnormal colonies or to colonies light on honey because the stimulus to rear brood will, initially, still further weaken the colonies. Brood rearing reduces the longevity of the nurse bees drastically, and the initial shock of brood-rearing until emergence of bees occurs is severely felt in small colonies.

Because most starvation occurs in early spring as brood-rearing accelerates, pay particular attention to the amount and position of honey stores. Feed heavy sugar sirup or full combs of honey from heavy colonies.

Key Points for Effective Overwintering of Honey Bees

Adequate honey stores in the proper location—a minimum of 90 lb (40.8 kg) of honey in October with about 45 lb (20.4 kg) of the honey in the top hive body.

Large population of young bees—only the best colonies should be carried over winter; any subnormal colonies should be united or disposed. Colonies with much queen trouble in late summer generally should not be overwintered.

Good wind protection—windbreaks, shrubs, trees, or light tar-paper wrap around the hive.

Therapeutic feeding—about 1 gal (3.8 l) of sugar sirup containing fumagillin for each colony, in the fall, to retard nosema disease development.

Upper entrance—to allow escape of moisture-laden air.

Bottom entrance closures—to prevent mice entry.

Pollen—a good reserve of bee bread in the combs, as well as early spring feeding of a good pollen supplement, to insure uninterrupted brood-rearing until pollen becomes abundant in the field.

Winter inspection—to make adjustments of honey stores, if necessary.

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